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# The Spotted Alfalfa Aphid

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## SUMMARY

The spotted alfalfa aphid, which kills alfalfa seedlings and defoliates, weakens, and sometimes kills older plants, has caused million-dollar losses to alfalfa growers since its entry into the United States in 1954. In the last 2 years it has spread through 30 States, increasing in numbers at a phenomenal rate.

Surveys conducted by the Agricultural Research Service and cooperating State workers have kept State Extension Service workers, State Experiment Station personnel, and growers alerted to its menace and spread, while State and ARS researchers are exerting every effort to discover means of controlling it. Although the aphid continues to invade new States yearly, control measures have been developed through research which promise to combat the insect more effectively than in any previous year. These control measures make use of natural enemies of the aphid, of insecticides, and of resistant varieties.

Scientists are continuing their search for means by which the spotted alfalfa aphid will be controlled so effectively that its damage will be negligible.

## THE SPOTTED ALFALFA APHID

The spotted alfalfa aphid, probably a native of the Mediterranean area, was discovered in southeastern New Mexico early in 1954. No one knows how the insect entered the country, but it spread with startling rapidity during the next 2 years, moving into 30 States. (See fig. 1.) Damage to alfalfa mounted as the pest spread. Reduced stands, low yields, poor-quality hay, and increased harvesting costs resulted in estimated losses to growers of more than \$42 million in 1956. Heaviest losses were suffered in California, Kansas, Oklahoma, Texas, Nebraska, Arizona, and New Mexico.

From the time of discovery, it was apparent that quarantine was impossible, since the tiny insect could be spread by air currents. An eradication program was not practical because of the insect's habits, including its ability to survive on a number of host plants other than alfalfa. Two things were begun immediately: a survey of infested areas to determine distribution and an aphid-research program.

Surveys were initiated by the Plant Pest Control Division of the Agricultural Research Service to determine the extent and intensity of the infestation. These have been continued with the cooperation of State workers. The results are published in the Department of Agriculture's weekly Cooperative Economic Insect Report, which serves to alert and inform regulatory, research, and Extension Service personnel throughout the country.

Research programs were undertaken by the Entomology Research Division and the Crops Research Division of ARS and by the agricultural experiment stations of infested States. The first objective was to identify the pest. The countries in which it is found, and the genus, have been established. The second objective was to develop methods of control. The methods developed to date are partially effective.

## THE INSECT

The spotted alfalfa aphid is a soft-bodied insect about half the size of a match head. The straw-colored body has six or more rows of dark spots along the back. Adults and the young aphids (nymphs) look alike except for size, although some of the adult females are winged. (See fig. 2.)

The newcomer closely resembles the yellow clover aphid--so closely, in fact, that it was first thought to be that insect. But the yellow clover aphid had never been known to infest alfalfa, and research workers soon learned that the new pest did not infest all of the clovers--the only group of plants seriously attacked by the yellow clover aphid.





## THE SPOTTED ALFALFA APHID

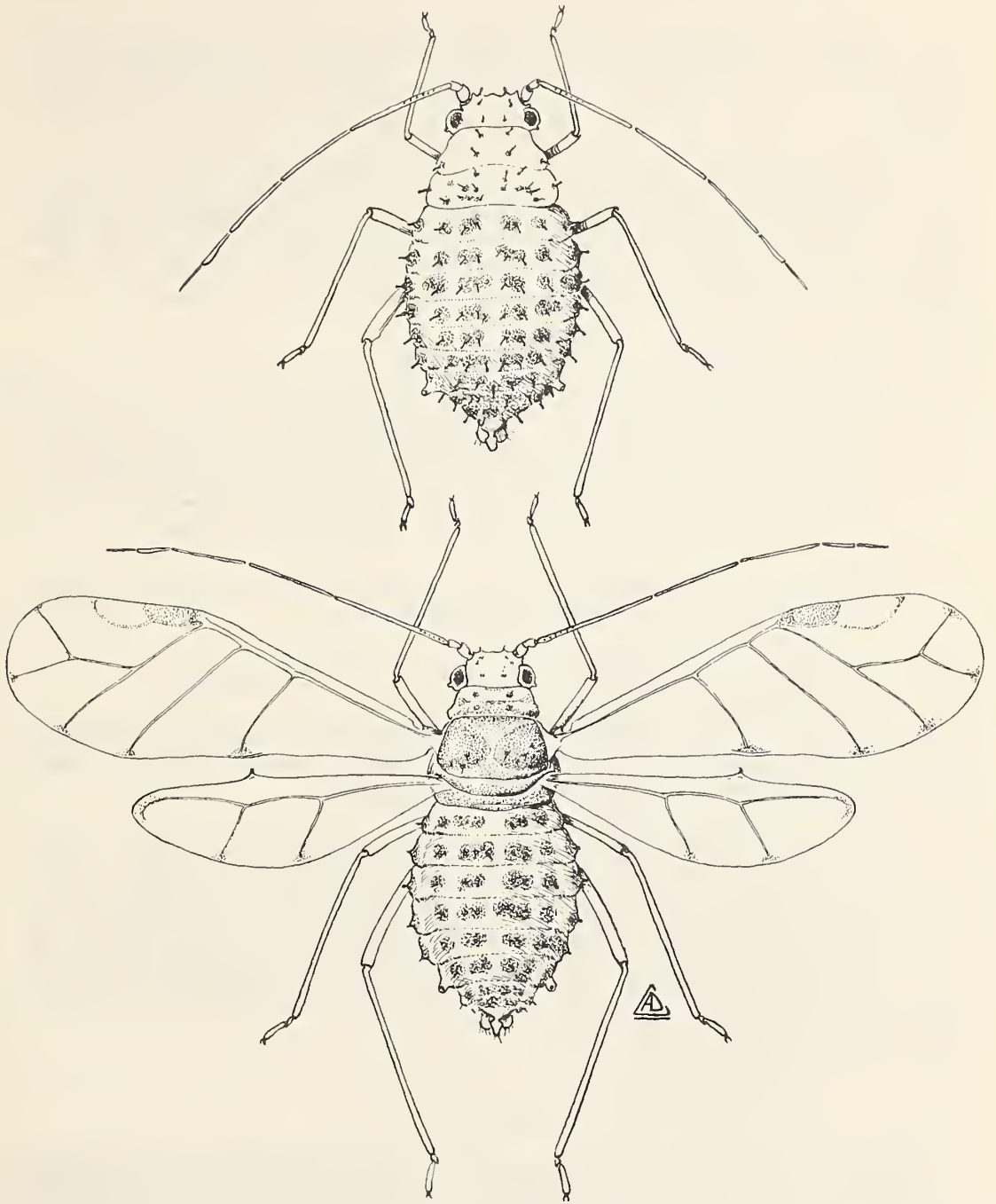


Fig. 2. --Above, wingless spotted alfalfa aphid; below, winged spotted alfalfa aphid.

Reproduction rates are highest where the weather is warm, and 20 or more generations may be produced annually in the South, in contrast with the single generation produced each year by many insects.

Where winters are warm, the spotted alfalfa aphid reproduces in the same manner as aphids in general. Males are few in number, and successive generations of females bear living young the year around, without mating.

The spotted alfalfa aphid can survive temperatures below freezing but entomologists doubt that it can overwinter in the northern part of its range in the United States. They also believe that, 'unlike many other aphids, spotted alfalfa aphid males do not increase in numbers as cold weather approaches, and females do not lay eggs that overwinter.

These beliefs are based on the following facts:

1. Infestation patterns in Nebraska indicate that the alfalfa aphid did not survive the winter of 1955-56. The pests invaded Nebraska in 1955, but the following year they were not reported until July, indicating that those found were newly arrived aphids from the South rather than aphids which had survived the winter.
2. Fall population counts, based on sweeps through infested fields in Nebraska, have shown no males present.
3. Careful searches in these areas have located no eggs.

If the pest does not overwinter in the northern part of its range and does not lay eggs that hatch in the spring, damage will probably be less extensive and spread less rapid than in the South.

The exact northern limit of the alfalfa aphid's winter range cannot be fixed at this time, because the minimum temperature the aphid can tolerate under varying conditions has not been determined. It seems likely, however, that the average annual minimum temperature in areas north of a line drawn through central Kansas, Missouri, Illinois, and Ohio, and through southern Pennsylvania and New Jersey is normally too low for the spotted alfalfa aphid to survive the winter.

### Feeding Habits

The aphid inserts its hollow stylet, or mouth-dagger, into the plant and sucks out the juices, which causes the leaves to turn yellow and drop off. At the same time, the pest injects a saliva that is apparently toxic to the plant and deposits a sticky excretion on the stem. The combined effect kills seedlings, stunts growing plants, and causes mature plants to produce stemmy, low-quality hay. The honeydew excretion is favorable for the growth of a black mold which discolors the hay and further reduces its



quality. In addition, the honeydew clogs harvesting equipment and makes dehydration difficult. Infestation of alfalfa fields results in reduced stands, low yields, poor-quality hay, and increased harvesting costs.

## RESEARCH TO PROVIDE CONTROL

Research has been undertaken along many lines to establish a method or combination of methods that will effectively control the spotted alfalfa aphid. These research projects include biological control, the use of insecticides, and the development of resistant varieties.

### Biological Control

Biological control involves the use of natural enemies of the spotted alfalfa aphid. These natural enemies include predators, parasites, and fungi. So far the degree of control achieved by these means has varied in different areas, and it is assumed that these variations are the result of environmental differences. In all areas it is apparent that existing enemies can at least hold down light infestations.

#### Predators

Predators that attack the alfalfa aphid include lady beetles, syrphid flies, lacewing flies, damsel bugs, big-eyed bugs, pirate bugs, and several species of predaceous beetles and spiders. These enemies kill and feed directly on the aphids. Some of them are found in almost every infested State, but they have not been effective in controlling heavy infestations. The search abroad, by California and ARS entomologists, has yielded several additional species of predators which are being tested in the laboratory against the spotted alfalfa aphid. Those showing promise will be reared and released in infested States.

#### Parasites

Parasites known to be fatal to the alfalfa aphid include three species of wasps, which have been imported from France and the Near East by California and the ARS. These wasps deposit their eggs in the abdomen of the aphid, rather than killing and eating the aphid directly, as do the predators. The wasp larvae, hatching from the eggs, kill the aphid by feeding upon the internal organs of the host. The larvae then pupate in the dead aphids. The bodies of these dead aphids are known as mummies and may be distributed in other infested alfalfa fields. Adult wasps emerging from the mummies soon parasitize living aphids. Wasps, reared in the laboratory, may also be released in infested fields for control purposes.

During 1956 nearly 1, 300, 000 of these parasitic wasps were reared in California and ARS laboratories and released in the 9 infested States that are participating in the Department's cooperative rearing and release program. Wasp stocks are being maintained at Albany, Calif., and Moorestown, N. Y., laboratories for propagation and release in infested States during 1957.

## Fungi

Five species of fungi that cause diseases in spotted alfalfa aphid populations have been discovered by California and ARS insect pathologists. The diseases caused by these fungi are known to limit themselves to aphids in general and perhaps to the spotted alfalfa aphid in particular. The fungi can be applied to alfalfa fields in the bodies of dead aphids, or the fungi spores can be sprayed onto the fields in a water suspension. Once in the field, however, the disease soon spreads. This spread may be enhanced when larger quantities of the spores become available, or when a more effective means of distributing them in the fields is found.

Under specific conditions in California, these 5 species of fungi have initiated epizootic diseases of such proportions that aphids have been effectively controlled. The results of these tests indicate that humidity is important to the reproduction of the fungi, and that best results will be obtained in humid areas and in irrigated fields.

The California Agricultural Experiment Station and the Agricultural Research Service are cooperating in the development of methods for increasing fungi numbers, reshipping them, releasing them in the field, and making follow-up surveys to determine their effectiveness. Additional releases are planned in the spring of 1957.

## Insecticides

### Forage Applications

Two organic phosphorus compounds, malathion and parathion, are being recommended for use on crops grown for forage or for seed harvest. These compounds, applied as a spray or dust, remain on the plants for only a short time and are not toxic to livestock unless the alfalfa is fed within a limited number of days after treatment: 7 days after application of malathion or 15 days following treatment with parathion. The following applications are recommended:

1. Malathion emulsifiable concentrate containing 5 pounds of malathion per gallon: 1 pint (0.6 pound of malathion) per acre in a water spray.
2. Malathion 5-percent dust: 15 pounds (0.75 pound of malathion) per acre.

3. Parathion 25-percent emulsifiable concentrate: 1 pint (0.25 pound of parathion) per acre in a water spray.

These insecticides are not one-shot treatments, however. Three or more applications a season may be necessary, and costs involved may make insecticidal control uneconomic. There is also the possibility that the alfalfa aphid may build up resistance to certain insecticides, as other insects have done.

### Seed Treatments

ARS and State Agricultural Experiment Station entomologists are studying a number of insecticides as aphid killers when applied as seed treatments. Some of the most promising of these are systemic in their action.

Systemic insecticides are absorbed by the root after the seed sprouts, and the insecticide is carried to all the growing parts by the plant juices. This movement makes the insecticide particularly effective against sucking insects, such as the aphid, which feed on plant juices.

Cooperative tests between ARS and the Arizona Agricultural Experiment Station have shown that alfalfa seedlings grown from seed treated with some systemic insecticides may be protected from spotted alfalfa aphid damage for 6 weeks after planting. Because this protection is provided during the period when infested alfalfa suffers its greatest mortality, seed-treatment experiments are receiving considerable attention.

### Resistant Varieties

The development of aphid-resistant varieties is a third line of research being pursued. Control by resistant varieties avoids the hazards of toxic residue from insecticides and the upsetting of nature's balance between host insects and their natural enemies. Resistant varieties also make control possible without direct cost to growers.

One alfalfa variety, Lahontan, has already demonstrated resistance to the spotted alfalfa aphid. Lahontan is the result of a cooperative breeding program in Nevada, between the ARS Crop Research Division and the Nevada Agricultural Experiment Station. It was developed as a winter-hardy variety resistant to bacterial wilt disease and the stem nematode, a parasitic eelworm which damages alfalfa crowns. The release of Lahontan for seed increase in 1954, by the Nevada and California agricultural experiment stations, coincided with the appearance of the spotted alfalfa aphid. During that year entomologists and alfalfa breeders of the Arizona, California, and Nevada agricultural experiment stations and of the ARS found that Lahontan made a good stand in aphid-infested plots, while other varieties were killed out or severely damaged. Greenhouse and nursery tests not only substantiated these observations, but revealed that, when



subjected to concentrated populations of aphids, Lahontan was scarcely injured. Seedling mortality of popularly grown varieties, similarly infested, ranged from 70 to nearly 100 percent. Under conditions of infestation, Lahontan outyielded the susceptible varieties by 200 to 300 percent.

Lahontan's resistance to the spotted alfalfa aphid, as well as its resistance to bacterial wilt and the stem nematode, created a demand for seed that exceeded the supply. In the fall of 1956, however, nearly 2 million pounds of certified seed was made available--nearly 100 times the supply available the previous year.

Lahontan is already demonstrating its value, either as a long-range or a stop-gap variety, in certain areas where the spotted alfalfa aphid is a serious problem--particularly, the irrigated sections of Arizona, California, Colorado, Nevada, and Utah. Despite its resistant qualities, Lahontan is not the full answer to the aphid problem for the United States as a whole: (1) Lahontan is of doubtful value in the more humid areas, since it is susceptible to certain leaf and stem diseases that flourish under humid conditions. (2) Its value is also doubtful in areas where winter forage is important, since Lahontan is dormant during the winter.

Other sources of resistance are also being explored and resistant plants have been found in several varieties.

## THE OUTLOOK

Although spotted alfalfa aphid control measures developed so far are only partially effective, the outlook is by no means dark. Biological control, which has succeeded under some irrigated conditions, holds promise for humid areas where disease-causing fungi flourish. Insecticides make possible sudden decimations of aphid populations. Seed treatments may be developed that will protect seedlings during the plant's most vulnerable period. Lahontan is providing varietal resistance in the areas to which it is adapted. The groundwork for effective control has been laid.

Research is continuing with these control methods. The search for natural enemies--at home and abroad--goes on, in an effort to discover one or more that will provide a higher degree of control. A number of new insecticides--systemic and non-systemic--are being tested as forage and seed treatments. State and Federal plant breeders are working to transfer Lahontan's aphid resistance to varieties adapted to other areas and have met with success under greenhouse conditions. If these new strains show a high-degree of resistance under field conditions this season, production of certified seed can begin.

All of this research will take time, and complete control may not be accomplished in the coming year. Nevertheless State and Federal workers, and growers, will be better equipped to fight the invasion than ever before, and control of the aphid menace can become increasingly effective.





